

Remarks

In the office action, claims 1, 2, 4 - 7, 11 - 19, 23 and 24 were rejected under 35 U.S.C. §103(a) over U.S. Patent No. 5,512,745 (to Finer et al.) in view of U.S. Patent No. 6,775,049 (to So); claim 3 was rejected under §103(a) over Finer in view of So and further in view of U.S. Patent No. 6,864,980 (to Te Kolste et al.); claim 8 was rejected under §103(a) over Finer in view of So and further in view of U.S. Patent No. 6,266,476 (to Shie et al.); claim 9 was rejected under §103(a) over Finer in view of So and further in view of U.S. Patent No. 5,887,009 (to Mandella et al.); and claim 10 was rejected under §103(a) over Finer in view of So and further in view of U.S. Patent No. 6,373,868 (to Zhang). The drawings were also objected to, and claims 20 - 22 were also rejected under 35 U.S.C. §112, ¶2.

Each of independent claims 1, 11, 12, 18, 19 and 23, therefore, was rejected in view of the Finer et al. and So references.

The Finer et al. reference discloses a system for optically trapping micrometer-sized spheres (or handles) to which molecules may be attached. The system of Finer et al., however, requires the use of multiple laser beams in order to provide multiple optical traps to manipulate the handles simultaneously. In particular, the Finer et al. reference states that:

Because two focal regions are needed to manipulate the two handles 1, 2, two lasers could be used. Alternatively, one laser may be used with an optical scheme that will ‘split’ the single laser beam into two or more laser beams.

Finer et al., col.5, lines 33 - 36.

The Finer et al. reference further discloses with reference to Figure 5 thereof, a system in which a single laser output is split into two separate beams using a beam splitter and movable mirrors to provide two separate beams that are directed toward a sample very close to one another along a path 63 so that each may be used to manipulate a handle. Manipulation of the

two beams is disclosed to be achieved using motorized mirrors along one path for “crude positioning” of one of the optical traps (Finer et al., col.7, lines 35 - 37). A specific example of such a system is also disclosed in col.10, lines 18 - 34 in which two optical traps were produced by splitting a laser beam prior to an acousto-optic modulator using a half-wave plate followed by a polarizing beam splitter.

Claim 1 is directed to an optical manipulation system comprising an array of focusing elements, each of which focuses an electromagnetic energy beam from an array of beamlet sources into an array of focal spots in order to manipulate a plurality of samples on an adjacent substrate. As noted in the office action, the Finer et al. reference does not disclose the use of an array of beamlet sources, let alone an array of such sources that are focused into an array of focal spots. The Finer et al. reference teaches only that a single source may be split into two beams that are handled separately. The systems of Finer et al., in fact, recombine the two beams (at beam splitter 37) for focusing onto the substrate (by focusing lens 38). Any manipulation is then achieved by leaving one beam in place and moving the other beam through the use of “crude positioning” of mirrors in the second beam path (Finer et al., col7, lines 35 - 37).

The So reference discloses an optical digital signal processing system that includes a digital micromirror device. With reference to Figure 2A, each micromirror is disclosed to be either turned on or off (So, col.2, lines 56 - 66). There is no disclosure in the So reference of using any of the mirrors of the digital micromirror device 30 in other than a full on or full off state as would be required to provide the necessary manipulation of particles. Moreover, the So reference does not disclose the use of an array of focusing elements, each of which focuses an electromagnetic energy beam. The So reference instead discloses the use of either a single lens or a lens combination wherein energy from all of the “on” mirrors passes through all of the focusing len(s). Even if, therefore, the So reference were to disclose an analog use of the mirrors

(which it does not) it still does not disclose the use of an array of focusing elements, each of which focuses an electromagnetic energy beam from an array of sources into an array of focal spots.

Applicant submits, therefore, that the subject matter of claim 1 is not disclosed, taught or in any way suggested by any combination of the teachings of the Finer et al. and So references. Not only is there no nexus between these references to provide the necessary teaching to combine them, but even if the So reference disclosed an analog use of a micromirrors, the reference does not disclose, teach or suggest the use of an array of focusing elements as claimed in claim 1. Because each of claims 2 - 10 depends directly from claim 1, each of claims 1 - 10 is submitted to be in condition for allowance.

As amended herein, claim 11 is directed to a parallel optical manipulation system comprising an array of focusing elements, and an array of sources, wherein each source is positioned to selectively direct electromagnetic energy toward a focusing element, and each focusing element is positioned to direct a focused beam toward a particle to be manipulated such that a plurality of independent pairs of light traps may be provided. Neither the Finer et al. reference nor the So reference, nor any combination therefore, disclose, teach or suggest such a system. There is no disclosure in the Finer et al. reference for providing a plurality of pairs of light traps, and it is not at all clear how one would modify the system of Finer et al. to achieve this. Again, the So reference discloses a digital micromirror that selectively directs energy toward a common focusing lens. Applicant submits, therefore, that the subject matter of claim 11 is not disclosed, taught or in any way suggested by any combination of the teachings of the Finer et al. and So references.

As amended herein, claim 12 is directed to a parallel optical manipulation system that includes an array of focusing elements, and an array of directionally selective elements, wherein

each directionally selective element is positioned to selectively direct electromagnetic energy toward a focusing element, and each focusing element is positioned to direct a focused beam toward a particle to be manipulated such that each directionally selective element may be employed to move a focused beam to thereby manipulate a particle. Neither the Finer et al. reference nor the So reference, nor any combination therefore, disclose, teach or suggest such a system. Again, there is no disclosure in the Finer et al. reference for providing an array of directionally selective elements that may be employed to move a focused beam to thereby manipulate a particle, and it is not at all clear how one would modify the system of Finer et al. to achieve this. Applicant submits, therefore, that the subject matter of claim 12 is not disclosed, taught or in any way suggested by any combination of the teachings of the Finer et al. and So references. Because each of claims 13 - 17 depends directly from claim 12, each of claims 12 - 17 is submitted to be in condition for allowance.

Claim 18 is directed to a system that includes comprising an array of focusing elements and an array of micro-mirrors each of which is associated with a focusing element and may be moved with respect to the associated focusing element to selectively direct a beamlet of electromagnetic energy toward a plurality of selectable locations on the focusing element. Again, neither the Finer et al. reference nor the So reference, nor any combination therefore, disclose, teach or suggest such a system. Applicant submits, therefore, that the subject matter of claim 18 is not disclosed, taught or in any way suggested by any combination of the teachings of the Finer et al. and So references.

Claim 19 is directed to a method of manipulating particles using electromagnetic energy, wherein the method includes the steps of providing an array of beamlets that are directed toward an array of focusing elements, focusing each of the beamlets toward a plurality of particles, and selectively controlling each of the beamlets to manipulate the plurality of particles. Neither the

Finer et al. reference nor the So reference, nor any combination therefore, disclose, teach or suggest such a method. Again, there is no disclosure in the Finer et al. reference the use of an array of focusing elements and the step of focusing each of a plurality of beamlets toward a plurality of particles. Applicant submits, therefore, that the subject matter of claim 19 is not disclosed, taught or in any way suggested by any combination of the teachings of the Finer et al. and So references. Because each of claims 20 - 22 depends directly or indirectly from claim 19, each of claims 19 - 22 is submitted to be in condition for allowance.

Claim 23 is directed to a method that includes the steps of providing an array of micro-mirrors that receive an electromagnetic field and provide an array of beamlets that are directed toward an array of focusing elements, focusing each of the beamlets toward a plurality of particles, and selectively controlling each of the micromirrors to manipulate the plurality of particles. Neither the Finer et al. reference nor the So reference, nor any combination therefore, disclose, teach or suggest such a method. There is no disclosure in these references of the use of an array of focusing elements, the step of focusing each of a plurality of beamlets toward a plurality of particles, nor the step of selectively controlling each of array of micromirrors to manipulate particles. Applicant submits, therefore, that the subject matter of claim 23 is not disclosed, taught or in any way suggested by any combination of the teachings of the Finer et al. and So references. Because claim 24 depends directly from claim 23, each of claims 23 - 24 is submitted to be in condition for allowance.

Each of claims 1 - 24, therefore is in condition for allowance. Favorable action
consistent with the above is respectfully requested.

Respectfully submitted,



William E. Hilton
Registration No. 35,192
Gauthier & Connors LLP
225 Franklin Street, Suite 2300
Boston, Massachusetts 02110
Telephone: (617) 426-9180
Extension 111